Amendments to the Claims

The listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Original) An indirect measurement system for determining an estimated value of a parameter of interest of an object, comprising:

a sensor that produces a raw measurement that is indirectly representative of said parameter of interest of said object;

a correction function that corrects said raw measurement to a corrected measurement to minimize measurement differences between said indirect measurement system and a reference indirect measurement system;

a reference map function that estimates said estimated value of said parameter of interest of said object based on said corrected measurement; and

a correction function fitting procedure that fits said correction function based on reference values for one or more calibration samples measured on or simulated for said reference indirect measurement system and corresponding values measured on said indirect measurement system.

2. (Original) An indirect measurement system in accordance with claim 1, wherein:

said correction function comprises one of a low-order polynomial function and a parametric function characterized by a small number of parameters.

3. (Original) An indirect measurement system in accordance with claim 1, comprising:

a reference map function fitting procedure that fits said reference map function based on known values of the parameter of interest associated with each of one or more reference calibration samples and corresponding reference

values for said one or more reference calibration samples measured on or simulated for said reference indirect measurement system.

4. (Original) An indirect measurement system in accordance with claim 1, comprising:

a classification function that classifies said object into one of a plurality of classes based on said estimated value of said parameter of interest.

5. (Original) A system for calibrating a first indirect measurement system with respect to a second indirect measurement system, said first indirect measurement system comprising a sensor that produces a raw measurement that is indirectly representative of a parameter of interest of an object sensed by said sensor, a correction function that corrects said raw measurement to a corrected measurement to minimize measurement differences between said first indirect measurement system and said second indirect measurement system, and a reference map function that estimates an estimated value of said parameter of interest of said object based on said corrected measurement, said system comprising:

a correction function fitting procedure that fits said correction function based on reference values for one or more calibration samples measured on or simulated for said second indirect measurement system and corresponding values measured on said first indirect measurement system.

6. (Original) A system in accordance with claim 5, wherein:

said correction function comprises one of a low-order polynomial function and a parametric function characterized by a small number of parameters.

7. (Original) A system in accordance with claim 5, wherein:

said correction function fitting procedure permits updating said correction function without updating said reference map function.

8. (Original) A system in accordance with claim 5, comprising:

a reference map function fitting procedure that fits said reference map function based on known values of the parameter of interest associated with each of one or more reference calibration samples and corresponding reference values for said one or more reference calibration samples measured on or simulated for said second indirect measurement system.

9. (Original) A method for calibrating a first indirect measurement system with respect to a second indirect measurement system, said first indirect measurement system comprising a sensor that produces a raw measurement that is indirectly representative of a parameter of interest of an object sensed by said sensor, a correction function that corrects said raw measurement to a corrected measurement to minimize measurement differences between said first indirect measurement system and said second indirect measurement system, and a reference map function that estimates an estimated value of said parameter of interest of said object based on said corrected measurement, said method comprising the steps of:

obtaining measurement values of one or more calibration samples measured on said first indirect measurement system; and

fitting said correction function based on said obtained measurement values of said one or more calibration samples and corresponding known reference values measured on or simulated for said second indirect measurement system.

10. (Original) A method in accordance with claim 9, wherein:

said correction function comprises one of a low-order polynomial function and a parametric function characterized by a small number of parameters.

11. (Original) A method in accordance with claim 9, further comprising the steps of:

re-obtaining measurement values of said one or more calibration samples measured on said first indirect measurement system; and

re-fitting said correction function based on said re-obtained measurement values of said one or more calibration samples and corresponding known reference values measured on or simulated for said second indirect measurement system.

12. (Original) A method in accordance with claim 9, further comprising the steps of:

obtaining reference values of one or more reference calibration samples measured on or simulated for said second indirect measurement system; and

fitting said reference map function based on said obtained reference values of said one or more reference calibration samples to corresponding known values of the parameter of interest associated with each of said one or more reference calibration samples.

13. (Original) A method in accordance with claim 12, further comprising:

updating said correction function without updating said reference map function.

14. (Original) A computer readable storage medium tangibly embodying program instructions implementing a method for calibrating a first indirect measurement system with respect to a second indirect measurement system, said first indirect measurement system comprising a sensor that produces a raw measurement that is indirectly representative of a parameter of interest of an object sensed by said sensor, a correction function that corrects said raw measurement to a corrected measurement to minimize measurement differences between said first indirect measurement system and said second indirect

measurement system, and a reference map function that estimates an estimated value of said parameter of interest of said object based on said corrected measurement, the method comprising the steps of:

obtaining measurement values of one or more calibration samples measured on said first indirect measurement system; and

fitting said correction function based on said obtained measurement values of said one or more calibration samples and corresponding known reference values measured on or simulated for said second indirect measurement system.

15. (Original) The computer readable storage medium of claim 14, wherein:

said correction function comprises one of a low-order polynomial function and a parametric function characterized by a small number of parameters.

16. (Original) The computer readable storage medium of claim 14, the method further comprising the steps of:

re-obtaining measurement values of said one or more calibration samples measured on said first indirect measurement system; and

re-fitting said correction function based on said re-obtained measurement values of said one or more calibration samples and corresponding known reference values measured on or simulated for said second indirect measurement system.

17. (Original) The computer readable storage medium of claim 14, the method further comprising the steps of:

obtaining reference values of one or more reference calibration samples measured on or simulated for said second indirect measurement system; and

fitting said reference map function based on said obtained reference values of said one or more reference calibration samples to corresponding

known values of the parameter of interest associated with each of said one or more reference calibration samples.

18. (Original) The computer readable storage medium of claim 17, the method further comprising the step of:

updating said correction function without updating said reference map function.

19. (Original) An automated inspection system, comprising:

an imaging system utilizing a source of penetrating radiation and one or more sensors to detect said penetrating radiation reflected by, scattered by, transmitted through, or emitted from an object and to generate an image of said object from which is derived one or more features of said object that are representative of a parameter of interest of said object;

a correction function that corrects said one or more features derived from said image of said object to one or more corresponding corrected features to minimize differences between said automated inspection system and a reference automated inspection system; and

a reference map function that estimates an estimated value of said parameter of interest of said object based on said one or more corresponding corrected features; and

a correction function fitting procedure that fits said correction function based on one or more features derived from one or more images of one or more calibration samples imaged on said automated inspection system and corresponding reference features derived from one or more reference images imaged on said reference automated inspection system.

20. (Original) An automated inspection system in accordance with claim 19, wherein:

said correction function comprises one of a low-order polynomial function and a parametric function characterized by a small number of parameters.

21. (Original) An indirect measurement system in accordance with claim 19, comprising:

a classification function that classifies said object into one of a plurality of classes based on said estimated value of said parameter of interest.

22. (Original) An automated inspection system in accordance with claim 19, wherein:

said source of penetrating radiation comprises x-rays; and

said image of said object comprises a gray level value representing detection of said x-rays.

23. (Original) An automated inspection system in accordance with claim 19, wherein:

said object comprises a solder joint of a printed circuit board and said parameter of interest is a solder thickness of said solder joint or a portion thereof.

24. (Original) A system for calibrating a first automated inspection system with respect to a second automated inspection system, said first automated inspection system comprising an imaging system utilizing a source of penetrating radiation and one or more sensors to detect said penetrating radiation reflected by, scattered by, transmitted through, or emitted from an object and to generate an image of said object from which is derived one or more features of said object that are representative of a parameter of interest of said object, a correction function that corrects said one or more features derived from said image of said object to one or more corresponding corrected features to minimize differences between said first automated inspection system and said second automated inspection system, and a reference map function that estimates an estimated

value of said parameter of interest of said object based on said one or more corresponding corrected features, said system comprising:

a correction function fitting procedure that fits said correction function based on one or more features derived from one or more images of one or more calibration samples imaged on said first automated inspection system and corresponding reference features derived from one or more reference images imaged on said second automated inspection system.

25. (Original) A system in accordance with claim 24, wherein:

said correction function comprises one of a low-order polynomial function and a parametric function characterized by a small number of parameters.

26. (Original) A system in accordance with claim 24, wherein:

said correction function fitting procedure permits updating said correction function without updating said reference map function.

27. (Original) A system in accordance with claim 24, comprising:

a reference map function fitting procedure that fits said reference map function based on known values of the parameter of interest associated with each of one or more reference calibration samples and corresponding reference features derived from one or more images of said one or more reference calibration samples imaged on said second automated inspection system.

28. (Original) A system in accordance with claim 24, wherein:

said source of penetrating radiation comprises x-rays; and

said image of said object comprises a gray level value representing detection of said x-rays.

29. (Original) A system in accordance with claim 24, wherein:

said object comprises a solder joint of a printed circuit board and said parameter of interest is a solder thickness of said solder joint or a portion thereof.

30. (Original) A method for calibrating a first automated inspection system with respect to a second automated inspection system, said first automated inspection system comprising an imaging system utilizing a source of penetrating radiation and one or more sensors to detect said penetrating radiation reflected by, scattered by, transmitted through, or emitted from an object and to generate an image of said object from which is derived one or more features of said object that are representative of a parameter of interest of said object, a correction function that corrects said one or more features derived from said image of said object to one or more corresponding corrected features to minimize differences between said first automated inspection system and said second automated inspection system, and a reference map function that estimates an estimated value of said parameter of interest of said object based on said one or more corresponding corrected features, said method comprising:

obtaining one or more features derived from one or more images of one or more calibration samples imaged on said first automated inspection system; and

fitting said correction function based on said one or more features derived from said one or more images of said one or more calibration samples and corresponding reference features derived from one or more reference images imaged on said second automated inspection system.

31. (Original) A method in accordance with claim 30, wherein:

said correction function comprises one of a low-order polynomial function and a parametric function characterized by a small number of parameters.

32. (Original) A method in accordance with claim 30, comprising:

re-obtaining one or more features derived from one or more images of said one or more calibration samples imaged on said first automated inspection system; and

re-fitting said re-obtained one or more features derived from said one or more images of said one or more calibration samples and corresponding reference features derived from one or more reference images imaged on or simulated for said second automated inspection system.

33. (Original) A method in accordance with claim 30, further comprising the steps of:

obtaining one or more reference features derived from one or more images of one or more reference calibration samples imaged on said second automated inspection system; and

fitting said reference map function based on said obtained one or more reference features derived from said one or more images of said one or more reference calibration samples and corresponding known values of the parameter of interest associated with each of said one or more reference calibration samples.

34. (Original) A method in accordance with claim 33, further comprising the step of updating said correction function without updating said reference map function.

35. (Original) A method in accordance with claim 30, wherein:

said source of penetrating radiation comprises x-rays; and

said one or more images or features derived therefrom comprises a gray level value reflecting detection of said x-rays penetrating said object.

36. (Original) A method in accordance with claim 30, wherein:

said object comprises a solder joint of a printed circuit board and said parameter of interest is a solder thickness of said solder joint or a portion thereof.

37. (Original) A computer readable storage medium tangibly embodying program instructions implementing a method for calibrating a first automated inspection system with respect to a second automated inspection system, said first automated inspection system comprising an imaging system utilizing a source of penetrating radiation and one or more sensors to detect said penetrating radiation reflected by, scattered by, transmitted through, or emitted from an object and to generate an image of said object from which is derived one or more features of said object that are representative of a parameter of interest of said object, a correction function that corrects said one or more features derived from said image of said object to one or more corresponding corrected features to minimize differences between said first automated inspection system and said second automated inspection system, and a reference map function that estimates an estimated value of said parameter of interest of said object based on said one or more corresponding corrected features, the method comprising the steps of:

obtaining one or more features derived from one or more images of one or more calibration samples imaged on said first automated inspection system; and

fitting said correction function based on said one or more features derived from said one or more images of said one or more calibration samples and corresponding reference features derived from one or more reference images imaged on said second automated inspection system.

38. (Original) The computer readable storage medium of claim 37, wherein:

said correction function comprises one of a low-order polynomial function and a parametric function characterized by a small number of parameters.

39. (Original) The computer readable storage medium of claim 37, the method further comprising:

re-obtaining one or more features derived from one or more images of said one or more calibration samples imaged on said first automated inspection system; and

re-fitting said re-obtained one or more features derived from said one or more images of said one or more calibration samples and corresponding reference features derived from one or more reference images imaged on or simulated for said second automated inspection system.

40. (Original) The computer readable storage medium of claim 37, the method further comprising:

obtaining one or more reference features derived from one or more images of one or more reference calibration samples imaged on said second automated inspection system; and

fitting said reference map function based on said obtained one or more reference features derived from said one or more images of said one or more reference calibration samples and corresponding known values of the parameter of interest associated with each of said one or more reference calibration samples.

41. (Original) The computer readable storage medium of claim 40, further comprising the step of:

updating said correction function without updating said reference map function.

42. (Original) A method in accordance with claim 37, wherein:

said source of penetrating radiation comprises x-rays; and

said one or more images or features derived therefrom comprises a gray level value reflecting detection of said x-rays penetrating said object.

43. (Original) A method in accordance with claim 37, wherein:

said object comprises a solder joint of a printed circuit board and said parameter of interest is a solder thickness of said solder joint or a portion thereof.